Tennessee Wildlife Resources Agency

Northern Bobwhite Management in Tennessee

2020-2025

A Strategic Plan for Northern Bobwhites in Tennessee

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Cover photo by Stephen Thomas

Executive Summary

The Northern Bobwhite (Colinus virginianus) is the state game bird of Tennessee and an important part of the state's landscape and heritage. Northern Bobwhite populations have declined dramatically range-wide since the 1950s, primarily due to landscape-scale habitat conversion and loss. Tennessee Wildlife Resources Agency (TWRA) collaborates with a myriad of partners to foster robust, self-sustaining Northern Bobwhite populations by enhancing existing and developing new habitats across the state.

The TWRA Northern Bobwhite Management Team (commonly called the Quail Team) is a group of TWRA staff assembled in 2017 to develop a statewide management plan, to inform management strategies and to advance the rebuilding of Northern Bobwhite populations in Tennessee.

The resulting Northern Bobwhite Management Plan will guide TWRA's management actions and planning for the next 5 years. The Plan includes a long-term vision, four broad goals, and supporting objectives with defined strategies to serve as a framework for Northern Bobwhite conservation in Tennessee.

Our vision is:

To rebuild, manage and monitor Northern Bobwhite populations in suitable habitats, while partnering with stakeholders and continuously evaluating conservation efforts with an adaptive management approach.

Acronyms

AKN	—	Avian Knowledge Network
BBS	—	Breeding Bird Survey
BMP	—	Best Management Practice
CIP	—	Coordinated Implementation Program of NBCI
CNGM	—	Center for Native Grasslands Management
CRP	—	Conservation Reserve Program
GIS	—	Geographical Information System
NBCI	—	National Bobwhite Conservation Initiative
NBTC	—	National Bobwhite Technical Committee
NRCS	—	Natural Resources Conservation Service, U. S. Department of Agriculture
QDA	—	Quail Demonstration Area
QF	—	Quail Forever
QFA	—	Quail Focal Area
SAFE	—	State Acres for Wildlife Enhancement
SGI	—	Southeastern Grasslands Initiative
TWRA	—	Tennessee Wildlife Resources Agency
UT	—	University of Tennessee

Goals

The foundation of the plan is its four major goals:

Habitat Goal

Increase the quality and quantity of Northern Bobwhite habitat in Quail Focal Areas, Anchor Wildlife Management Areas, and other lands that can potentially support self-sustaining populations.

Outreach Goal

Educate and engage stakeholders to help TWRA achieve the long-term vision of Northern Bobwhite conservation and management.

Population Goal

Through innovative management efforts, effective partnerships, and improved inventory and monitoring, increase the number of self-sustaining populations of Northern Bobwhite across Tennessee.

Research Goal

Working with partners, engage in priority research efforts to better understand the population and habitat needs of self-sustaining Northern Bobwhite populations in Tennessee.

Objectives

The following are the objectives for this plan:

- Assess, map, and prioritize Northern Bobwhite habitat across Tennessee.
- Improve monitoring, accountability and documentation of Northern Bobwhite conservation actions in Anchor WMAs.
- Seek opportunities to improve Northern Bobwhite habitat in public and private lands not managed by TWRA.
- Implement habitat enhancements in prioritized habitats.
- Improve and increase the frequency of interactions with internal and external stakeholders to encourage engagement in Northern Bobwhite conservation in Tennessee.
- Seek opportunities to support and implement efforts of partners and conservation organizations to promote effective, science-based Northern Bobwhite conservation range-wide.
- Educate hunters and other stakeholders about sustainable Northern Bobwhite hunting in Tennessee.
- Outreach to stakeholders and volunteers for assistance with all Northern Bobwhite conservation work statewide.
- Ensure that TWRA staff employ best management practices for Northern Bobwhite management.
- Monitor the status of Northern Bobwhite populations in QFAs and QDAs.
- Develop and implement feasible, standardized protocols to measure Northern Bobwhite harvest and hunter effort annually statewide.
- Document and monitor fundamental population characteristics of Northern Bobwhite in QFAs and QDAs, including sex- and age-specific survival, habitat use, mortality, morbidity, and reproductive success to inform best management practices.
- Collaboratively identify areas of critical information gaps and guide coordinated research efforts to benefit Northern Bobwhite management in Tennessee.
- Identify and rank areas for potential Northern Bobwhite translocations based on best translocation practices and guidelines.
- Explore the re-establishment and/or supplementation of Northern Bobwhite populations, using wild source populations only.

The vision, goals, objectives, and strategies outlined in this plan are those most important to implement within the next five years and will provide the most immediate benefit to Northern Bobwhite conservation and management in Tennessee. This plan is intended to be adaptive, thus new information and experience will inform changes to future objectives and strategies.

Introduction

The Northern Bobwhite (Colinus virginianus), also known as bobwhite quail or simply quail, is an iconic game bird ranging throughout much of North and Central America (Figure 1). In the United States, Northern Bobwhite are distributed over an area that is 1,900 miles north-south and over 2,500 miles east-west, with a rainfall gradient from greater than 48 inches/year to about 15 inches/year (The National Bobwhite Technical Committee (NBTC) 2011). This broad distribution is due to the species' ability to thrive in many different habitats (Burger 2001).

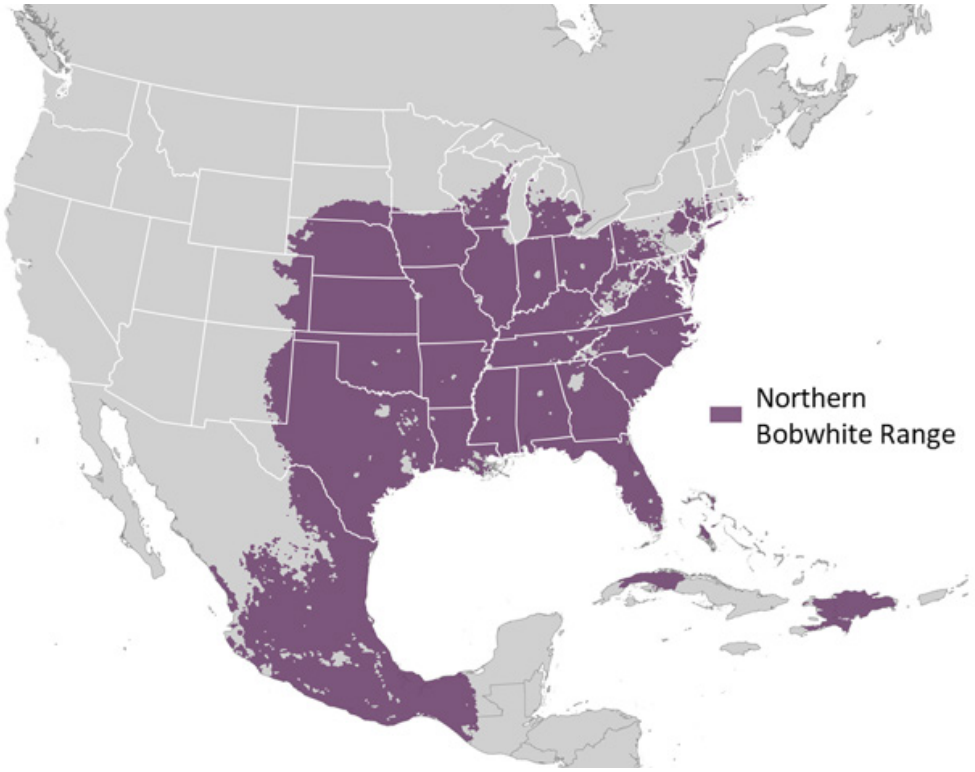

Figure 1. Northern Bobwhite range. From eBird 2017 and TWRA GIS Unit.

Northern Bobwhites are small, almost exclusively ground-dwelling, birds that have small home ranges and do not migrate. They live singly or in pairs during the spring and summer and form small flocks or coveys in the fall and winter. The diet of the Northern Bobwhite changes seasonally, but they primarily feed on seeds, small fruits, leaves, and insects. They require a matrix of varying habitats including grasslands, savannas, and open woodlands (Burger 2001). Recently disturbed lands are particularly important, as they provide a flush of new growth with outstanding nutrition and escape cover. Bird densities in robust, self-sustaining populations vary greatly in response to habitat quality, quantity and arrangement. Predation is likely a primary cause of mortality, particularly by avian predators (Burger 2001, Lake et al. 2002). A population size of 800 individuals in the fall is generally considered the minimum for long-term sustainability (Guthery et al. 2000). To sustain a population of this size, a minimum of 1,500 acres of year-round, high-quality Northern Bobwhite habitat is thought to be required. This minimum acreage is a hypothesis based on the Northern Bobwhite movement study of (Terhune et al. 2010) and the minimum viable bobwhite population work of Guthery et al. (2000).

TWRA's mission is to protect, preserve, and perpetuate Tennessee's wildlife and ecosystems for the sustainable use and recreational benefits for our state's residents and visitors.

The North American Model of Wildlife Conservation holds that wildlife is a public resource to be held in trust, by the government, for present and future generations (Organ et al. 2012). In Tennessee, Northern Bobwhites are managed by Tennessee Wildlife Resources Agency (TWRA), whose mission is to **protect, preserve, and perpetuate Tennessee's wildlife and ecosystems for the sustainable use and recreational benefits for our state's residents and visitors.**

The Northern Bobwhite is the state game bird of Tennessee and was once abundant across much of the state, providing significant recreational opportunities for wildlife watchers and hunters and substantial revenues to state and local economies. In 2011, 923,000 Tennessee residents hunted, representing nearly 20% of the state's population. When non-residents are included, nearly one million people hunted or fished in Tennessee and generated $1.9 billion dollars in expenditures (US Department of the Interior, US Fish and Wildlife Service, and US Department of Commerce, US Census Bureau 2012). Northern Bobwhite hunters in 11 southeastern states, including Tennessee, generated over $193 million of economic impact annually (Burger 1999).

For much of the last century, Northern Bobwhite populations have declined precipitously range-wide, including in Tennessee. Northern Bobwhite is now identified as a Species of Greatest Conservation Need in TWRA's State Wildlife Action Plan (TN State Wildlife Action Plan Team 2015). These nearly universal declines are primarily attributed to habitat loss and fragmentation.

This document is designed to serve as a management plan for Northern Bobwhite in Tennessee. The plan provides a history of Northern Bobwhite in Tennessee, a vision for conservation, goals, objectives and strategies to achieve the vision. It includes strategic guidance and lists specific actions which will be the most valuable to take over the next five years. It does not, however, identify every activity the agency will perform related to Northern Bobwhite and their management. Nonetheless, accomplishment of this plan will ensure key steps are taken to conserve and effectively manage Northern Bobwhite in the state.

As the scope and scale of human impacts on wildlife and natural resources escalates, traditional management methodologies must adapt (Allen et al. 2011). Northern Bobwhite management is strongly influenced by human activity and we must therefore be increasingly nimble and responsive to changing conditions and demands. The following strategies and objectives will likely change over time as Northern Bobwhite stakeholders, populations, habitats and management strategies are better understood, and objectives of this plan are accomplished.

The northern bobwhite was once very common in Tennessee. *Tom Wood*

History of Northern Bobwhite Management in Tennessee

It is likely that prior to European settlement, Northern Bobwhites occurred in a patchy distribution across the state and were primarily restricted to small pockets of habitat with varying densities based on habitat quality. Natural disturbance from wildfire or tornadoes would create patches of early successional habitat that supported small population explosions (Burger 2001).

With European settlement, growing numbers of farmsteads created outstanding Northern Bobwhite habitat through forest clearing, low-intensity livestock grazing, annual burning, and primitive rotational cropping (Burger 2001). The distribution and number of birds increased accordingly across the state. By the early 1900s, Northern Bobwhite were abundant across the state and habitat was plentiful and of outstanding quality.

Declines in the Northern Bobwhite abundance were noted as early as 1931 (Stoddard 1931) when much of their range had been settled and the huge flush of early successional habitat had diminished. Since 1966, populations of Northern Bobwhite have annually declined roughly 3.5% in the US and over 5% in Tennessee based on Breeding Bird Survey (BBS) counts (Figure 2).

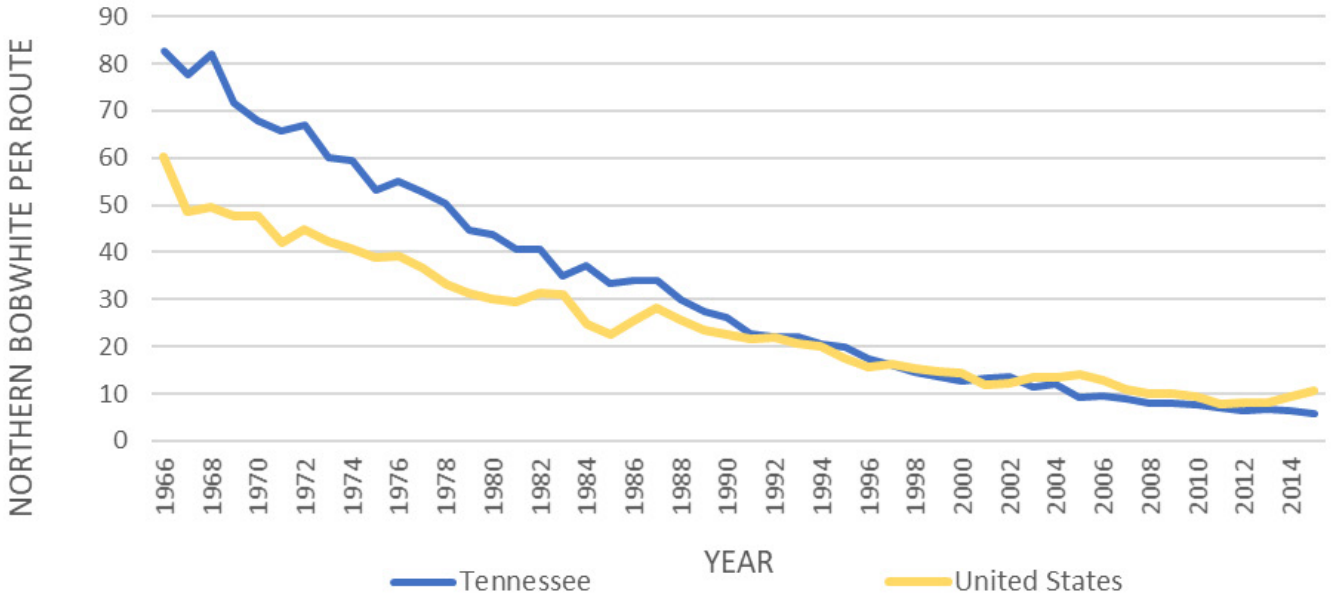

Figure 2. Annual index of abundance of Northern Bobwhite in the United States and Tennessee from the USGS Breeding Bird Survey (Pardieck et al. 2019).

The decline of Northern Bobwhites mimics that of many other species that rely on grassland-shrub habitats (NBTC 2011). The causes of these declines are multifaceted, interrelated, and cumulative but are assumed to be primarily associated with the loss and declining quality of critical early successional plant communities. Increasingly intensive and sterile farming practices, fire suppression, increased susceptibility to predation due to habitat changes (Brennan 1991), residential development, invasive weeds and disease may all be contributing factors in the range-wide decline of the species.

Partners In Flight (PIF), a joint venture of over 150 organizations focused on land bird conservation, identified the Northern Bobwhite as one of 24 Common Birds in Steep Decline—species that are numerous and/or widely distributed but have experienced troubling long-term population declines. PIF predicts that if the current population trends continue, the total population of Northern Bobwhite will be cut in half again in the next 10 years (Rosenberg et al. 2016).

Since the agency's inception in 1949, TWRA has focused on increasing Northern Bobwhite numbers and sustainability across the state. Most of the early emphasis of Northern Bobwhite management efforts were directed at rearing and releasing domestic Northern Bobwhite to supplement wild ones and planting food resources. Programs of propagation, distribution, and release of domestic Northern Bobwhite occurred from 1936 to 1957 (Marcum 1975). During the 1950s–1970's, efforts shifted to distributing seed and other plant materials to private landowners to improve private-land Northern Bobwhite habitat. None of these strategies proved effective in increasing Northern Bobwhite populations. Similar efforts were attempted throughout the United States with a similar lack of success.

Considerable empirical research has been completed in Tennessee to inform and support effective management. For many years, University of Tennessee faculty conducted Northern Bobwhite research at Ames Plantation, 18,400 acres of private land primarily used for bird dog field trials and agriculture in west Tennessee. These studies yielded an extensive body of research on Northern Bobwhite populations, condition, and habitat management (Dimmick 1971, Eubanks and Dimmick 1974, McRae and Dimmick 1982, Minser and Dimmick 1988). These studies provided the baseline data to inform Northern Bobwhite management in Tennessee.

More recent studies have examined predation on Northern Bobwhites by Cooper's hawks (Lake et al. 2002) and the negative effects of mycotoxins from soybeans (Grizzle et al. 2004, 2005) on Northern Bobwhite reproductive potential, and the incorporation of genetic material of domestic Northern Bobwhite into wild populations in Tennessee following releases (Evans et al. 2009).

Researchers in Tennessee have focused recently on habitat needs, including the establishment of native grasses to replace tall fescue pastures used extensively for grazing cattle (Harper et al. 2004, Harper 2017). In 2006, University of Tennessee, with TWRA support, established the Center for Native Grasslands Management (CNGM) to act as a catalyst for the development of native grass management systems to improve habitat for grassland wildlife, including the Northern Bobwhite. CNGM supports both outreach and research and aims to provide land managers and cattle producers the scientific background to effectively establish and maintain native grasslands.

Across the Northern Bobwhite range, recent conservation efforts have concentrated on increasing old field habitat (Harper 2017), the utility of prescribed fire (Warwick and Harper 2018), and native grassland restoration (Estes 2016). These studies further support how Northern Bobwhite habitat is best provided by early successional habitat and grasslands that are early- to mid-successional and regularly maintained by fire or other disturbance. In Texas and Oklahoma, large patches of uniform vegetation, areas with higher road densities, larger patches of pasture and cropland, and smaller patches of woodland were more associated with declining Northern Bobwhite populations than with stable populations (Miller et al. 2019).

Since the 1960s, a variety of U.S. Department of Agriculture (USDA) programs have been implemented on private lands in Tennessee to increase and improve available habitat for Northern Bobwhite. The Conservation Reserve Program (CRP) improves soil, protects water, and restores wildlife habitat. Several of the CRP Program Practices, including CP33 (Habitat Buffers for Upland Birds) and State Acres for Wildlife Enhancement (SAFE) CP38E (Bobwhite Habitat Restoration) are intended to specifically benefit Northern Bobwhite habitat. Although the SAFE Bobwhite Habitat practice is currently limited in Tennessee to 11,500 acres in 28 counties, it provides significant improvements to Northern Bobwhite habitat on private lands (Gudlin et al. 2019).

The most recent habitat programs are directed towards conversion of cool-season pasture lands and abandoned fields to native warm-season grasses and early successional plant communities (Harper et al. 2007, Harper 2017). These practices have been implemented on TWRA-managed and privately-owned lands. In 2018, the USDA Farm Bill incorporated language that prioritizes the planting of natives over nonnative vegetation specifically to benefit Northern Bobwhite and other native wildlife. TWRA has partnered with the USDA Natural Resource Conservation Service (NRCS) to hire biologists to deliver these types of habitat programs on private lands using federal funds, and Quail Forever (QF) has partnered with NRCS and the Southeastern Grasslands Initiative (SGI) to provide technical expertise. Although these programs have increased the quality and availability of important Northern Bobwhite habitats across Tennessee and the United States, Northern Bobwhite populations continue to decline.

Since 2002, TWRA has actively participated in and supported the Northern Bobwhite Conservation Initiative (NBCI), a group of state wildlife management agencies, federal agencies, and non-governmental partners working to restore and sustain Northern Bobwhite across its range. NBCI functions as a clearinghouse of best management practices (BMP), standardized scientific methodologies, and serves to steer collaborative restoration and management efforts nationwide. The vision, goals, and objectives identified in this plan are closely aligned with those of the NBCI and are intended to support its efforts.

Current Status

Northern Bobwhites can still be found throughout much of Tennessee, but relative abundance measures indicate steep and sustained declines. Since the USGS Breeding Bird Survey (BBS) was started in 1966, Northern Bobwhite populations in Tennessee have annually declined by more than 5% (Figure 2), for a total loss of nearly 85% range wide (Pardieck et al. 2019).

Habitat loss and degradation and their cumulative impacts are the greatest causes of the population decline (The National Bobwhite Conservation Initiative and The National Bobwhite Technical Committee (NBCI & NBTC) 2019). In response, current conservation efforts in Tennessee aim to collaboratively manage, monitor, and enhance Northern Bobwhite habitat.

In 2013, TWRA identified four Northern Bobwhite (Quail) Focal Areas, or QFAs. Each of these QFAs are intended to provide sufficient high-quality habitat to sustain a Northern Bobwhite population indefinitely (TWRA 2013) as well as to direct habitat management and enhancement efforts. Within and adjacent to the QFAs, TWRA-owned Wildlife Management Areas (WMAs) serve as anchors that focus on Northern Bobwhite habitat management (Figure 3). These Anchor WMAs are intended to provide high quality, intensively managed Northern Bobwhite habitat to support a self-sustaining population within the larger QFA.

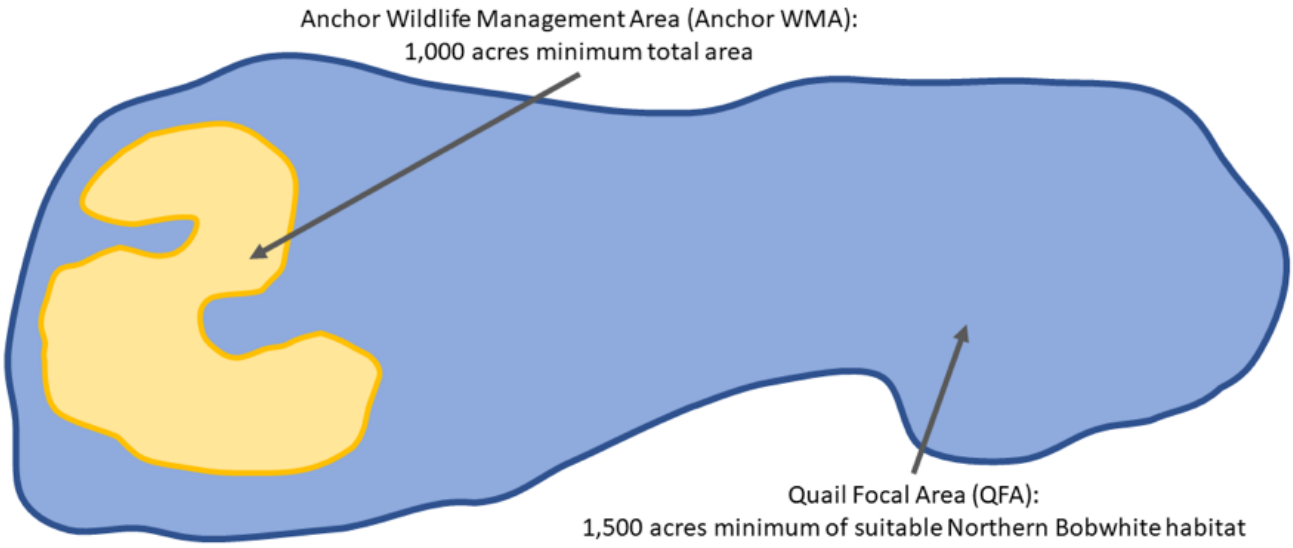

Figure 3. Depiction of an Anchor Wildlife Management Area (Anchor WMA) within the larger Quail Focal Area (QFA).

The four QFAs and their associated WMAs are: Bark Camp Barrens, Bridgestone-Firestone, Lick Creek, and Wolf River (Figure 4). The QFAs are located across Tennessee and comprised of both public and private lands, with one WMA serving as the anchor for each QFA (Figure 5). The WMAs make up a significant portion of total Northern Bobwhite habitat in the QFAs. In fact, these four areas comprise over 3,700 acres of early successional plant communities and have the potential to provide substantially more with targeted habitat management activities (TWRA 2018). Additional QFAs and associated Anchor WMAs will be evaluated and added as capacity allows.

	Anchor WMA (acres)	Total QFA (acres)
Bark Camp Barrens	3,345	18,704
Bridgestone-Firestone	7,265	16,461
Lick Creek	1,519	10,985
Wolf River	4,974	8,413

Figure 4. Acreage of Anchor Wildlife Management Areas (Anchor WMAs) and Quail Focal Areas (QFAs) in Tennessee.

In addition to the QFAs, Kyker Bottoms Refuge in Blount County is designated as a Quail Demonstration Area (QDA) and maintains the highest known densities of Northern Bobwhite in Tennessee of approximately 0.5 Northern Bobwhite/acre. The high-quality, intensively managed habitat showcases best management practices and the real impact they can have on producing sustainable, robust Northern Bobwhite populations. Additional QFAs and associated Anchor WMAs will be considered as capacity allows.

Figure 5. Location of Quail Focal Areas (QFAs) and Quail Demonstration Area (QDA) in Tennessee.

Since the establishment of the QFAs in 2014, over 20,000 acres have been actively managed with prescribed fire, targeted herbicide applications, timber harvest, disking, seeding, and various mechanical treatments (Figure 6). In addition to these targeted habitat enhancements, over 1,500 acres of former woodlands have been converted to early successional habitat through timber harvest.

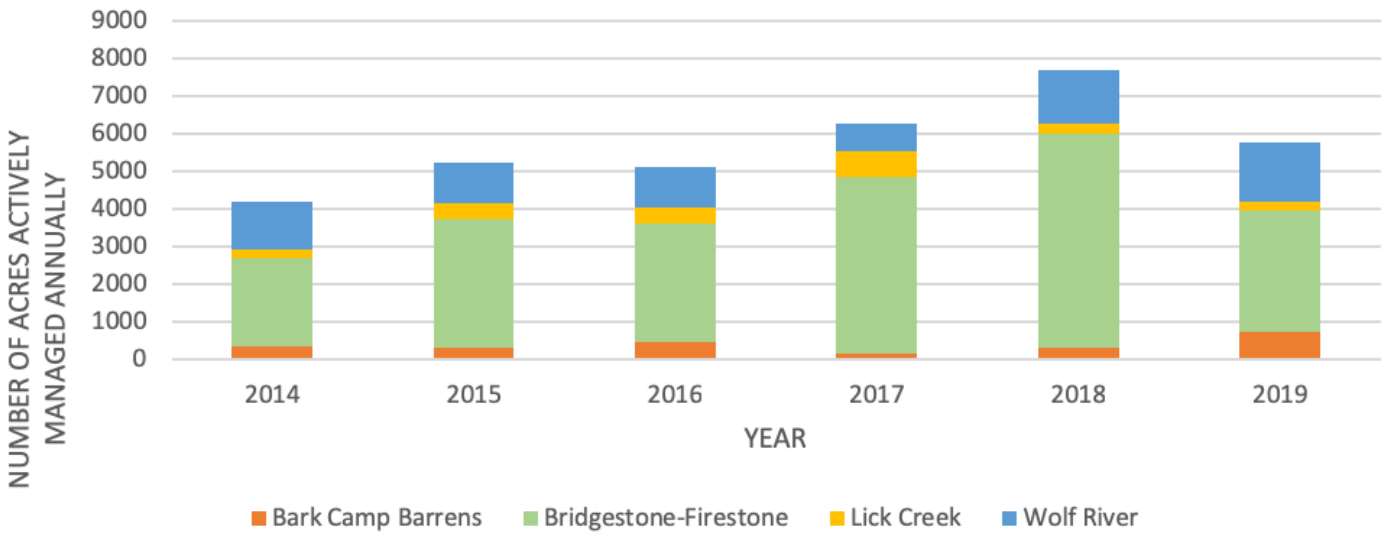

Figure 6. Habitat management in Anchor Wildlife Management Areas (Anchor WMAs) to benefit Northern Bobwhite (2014 – 2019)

Since 2017, TWRA has completed abundance monitoring surveys on all QFAs using a standardized protocol developed by NBCI. These abundance measurements are designed to document range-wide, long-term trends and are not designed to draw conclusions about changes in abundance at either the WMA or QFA scale. The Tennessee abundance data will be pooled and analyzed with other state's surveys to inform range-wide Northern Bobwhite management actions over the long-term.

One of the Anchor WMAs, Wolf River WMA, is designated as a NCBI Coordinated Implementation Program (CIP) focal area. NBCI CIP focal areas are contiguous areas designed to increase the probability of achieving target Northern Bobwhite densities through strategic habitat management efforts (Morgan et al. 2016). They form a national network of high-quality Northern Bobwhite habitat that serves as a platform for large-scale habitat management and provides measures of management success of Northern Bobwhite conservation efforts.

Each NBCI CIP focal area must have a minimum of 1,500 acres of year-round, high-quality Northern Bobwhite habitat that makes up a minimum of 25% of the total acreage in the focal area. Additionally, fall covey call point transects must be completed annually and habitat transects must be completed

at 1-, 5-, and 10-year intervals. Habitat management activities must be tracked and reported to NBCI annually. It is also recommended that Northern Bobwhite harvest in focal areas be managed and reported and that the release of domestic Northern Bobwhites is prevented or tracked if allowed.

In order to compare the success of management efforts in CIP properties, each has a reference area, with similar habitat characteristics and Northern Bobwhite populations, but without the intensive management. Northern Bobwhite populations and habitat quality on both properties are monitored with the same protocols and at the same intervals. The Wolf River Anchor WMA reference area includes approximately 20,000 acres of similar habitat. Future conditions will be monitored as outlined in NBCI's CIP guidelines (Morgan et al. 2016).

Even with TWRA's efforts described above, there remain many opportunities for habitat acquisition and enhancement across the state. In the late 2000's, NBCI led a standardized, coordinated mapping effort to identify areas of potentially suitable habitat in each of the 22 partner states. The Biologist Ranking Information (BRI) mapping sessions included a broad array of local Northern Bobwhite experts to incorporate local up-to-date and on-the-ground knowledge. All counties were assigned a rank of High, Medium, Low, or None based on habitat potential and social and economic characteristics affecting the suitability of potential and occupied habitat (NBTC 2011). The purpose of the maps is to highlight areas of opportunity for successful Northern Bobwhite habitat creation and enhancement.

The BRI maps indicate there are over 4 million acres in Tennessee with high potential to be restored as Northern Bobwhite habitat and an additional 8.2 million acres with moderate potential (Figure 7). Knowledge of the potential of these public and private lands will be useful in planning future habitat enhancement. The BRI will help guide decision-making for TWRA and partner habitat management actions.

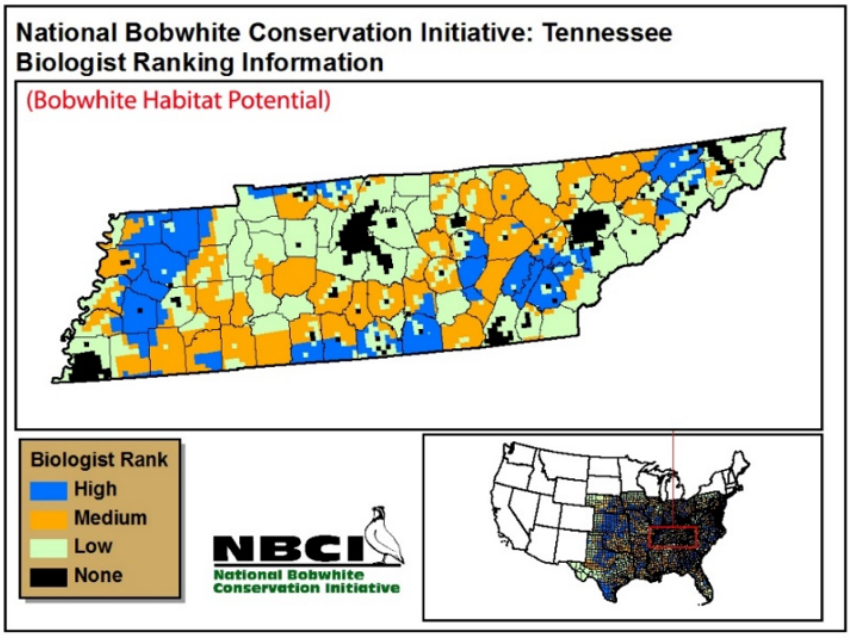

Figure 7. Northern Bobwhite habitat potential in Tennessee (NBTC 2011).

Sport hunting is an important component of Northern Bobwhite management in Tennessee. Regulations have varied little over time, and TWRA regulations currently allow Northern Bobwhite hunting from the first Saturday in November through the last day of February annually, with a daily bag limit of six. In areas of low Northern Bobwhite population density or areas of high hunter participation, sport hunting has been shown to be an additive source of mortality in Northern Bobwhite and can reduce the sustainability of populations (Williams et al. 2004, Rolland et al. 2010, Sands 2010). Therefore, some WMAs have regulations that are more restrictive to prevent overharvest and beginning with the 2020 season, all Anchor WMAs are closed to hunting. As TWRA conservation activities improve the populations in Anchor WMAs, opportunities for sport harvest will be reconsidered.

Annual harvest varies considerably and has historically been measured only sporadically in Tennessee. The most recent surveys were completed following the 2007 – 2008 and 2008 – 2009 hunting seasons. These surveys estimated that 159,155 Northern Bobwhite were harvested by 14,767 hunters during the 2007 – 2008 season (TWRA 2008), and 24,394 Northern Bobwhite were harvested by 7,115 hunters during the 2008 – 2009 season (TWRA 2009).

This wide disparity in annual estimated harvest is symptomatic of the difficulty in quantifying reliable harvest estimates and applying meaningful management prescriptions. Beginning with the 2019-2020 season, TWRA has established an annual survey of small game, waterfowl and furbearer hunters to estimate harvest, hunter effort, satisfaction, motivations and attitudes. This will provide annual Northern Bobwhite harvest estimates, and hunter effort that will inform future decisions regarding sport harvest.

Despite ongoing conservation efforts across the state, the Northern Bobwhite continues to decline. However, there

are a myriad of opportunities to improve the population and sustainability of the species. Generally, these opportunities can be broadly classified under Habitat, Outreach, Population, and Research goals. Implementation of these goals and associated objectives and strategies will inform Northern Bobwhite conservation in Tennessee by the creation and manipulation of quality habitat, communication with stakeholders, population management and ongoing research to inform best management practices.

Prescribed fire is one of the essential tools for maintaining Northern Bobwhite habitat. *Stephen Thomas*

Habitat Goal

Increase the quality and quantity of Northern Bobwhite habitat in Quail Focal Areas, Anchor Wildlife Management Areas, and other lands that can potentially support self-sustaining populations.

Objective 1

Assess, map, and prioritize Northern Bobwhite habitat across Tennessee

STRATEGY 1.1

Develop a map of modeled Northern Bobwhite habitat statewide that incorporates occupancy and abundance data in Habitat Strategy 1.2, staff knowledge, GIS habitat layers, NBCI's BRI mapping data, NBCI habitat guidelines, primary research, and eBird and USGS Breeding Bird Survey data.

Primary Responsibility: Species Coordinator, WMA Managers, Habitat Biologists
Timeframe: Fall 2020 - Fall 2022

STRATEGY 1.2

Inventory Northern Bobwhite occupancy in all WMAs and a subset of those public and private lands identified as "high potential" habitat in the Biologists Ranking Index map (The National Bobwhite Technical Committee 2011).

Primary Responsibility: Species Coordinator, WMA Managers, Habitat Biologists
Timeframe: Spring 2021 - Fall 2022

STRATEGY 1.3

Develop criteria for prioritizing habitat actions and acquisitions based on the map generated in Habitat Strategy 1.1.

Primary Responsibility: Species Coordinator, Northern Bobwhite Management Team
Timeframe: Spring 2021 - Fall 2022

STRATEGY 1.4

Prioritize and review the suitability of current QFAs and explore the replacement or addition of new QFAs.

Primary Responsibility: Species Coordinator, Northern Bobwhite Management Team, WMA Coordinators, WMA Managers
Timeframe: Fall 2021 and repeat every five years

STRATEGY 1.5

Develop, implement, and maintain a ranking criteria and tier system for all WMAs based on current and potential value to Northern Bobwhite conservation.

Primary Responsibility: Species Coordinator, Northern Bobwhite Management Team, WMA Coordinators, WMA Managers
Timeframe: Winter 2021

Objective 2

Improve monitoring, accountability and documentation of conservation actions completed in Anchor WMAs to benefit Northern Bobwhite

STRATEGY 2.1

Track and report annually all habitat enhancement efforts to benefit Northern Bobwhites in all Anchor WMAs.

Primary Responsibility: Anchor WMA Managers, Species Coordinator, WMA Coordinator
Timeframe: Fall 2020 and annually

STRATEGY 2.2

Update existing operational plans for Anchor WMAs to include enhancement of Northern Bobwhite habitat.

Primary Responsibility: Anchor WMA Managers, Species Coordinator
Timeframe: Fall 2020 and annually

STRATEGY 2.3

Incorporate specific metrics in personnel workplans to ensure annual enhancement activities and monitoring are completed.

Primary Responsibility: WMA Coordinator
Timeframe: Fall 2020 and annually

STRATEGY 2.4

Complete NBCI CIP (NBTC 2020) habitat monitoring protocols at recommended 5-year intervals on each Anchor WMA.

Primary Responsibility: Anchor WMA Managers, WMA Coordinators, Species Coordinator
Timeframe: Summer 2020 and repeat every five years.

Objective 3

Seek opportunities to improve Northern Bobwhite habitat in public and private lands not managed by TWRA

STRATEGY 3.1

Identify lands, particularly in QFAs, that are not managed by TWRA but contain high-value actual and/or potential Northern Bobwhite habitat.

Primary Responsibility: Habitat Biologists, Northern Bobwhite Management Team, Anchor WMA Managers

Timeframe: Winter 2020 and ongoing

STRATEGY 3.2

Encourage and incentivize the use of Best Management Practices on lands, particularly in QFAs, that are not managed by TWRA but contain high-value actual and/or potential Northern Bobwhite habitat.

Primary Responsibility: Habitat Biologists, Northern Bobwhite Management Team, Anchor WMA Managers

Timeframe: Spring 2021 and ongoing

Objective 4

Implement habitat enhancements in prioritized habitats

STRATEGY 4.1

Increase the quality and/or quantity of early successional plant communities in each Anchor WMA by a minimum of 5 percent (or 100 acres on properties smaller than 2,000 acres) annually.

Primary Responsibility: Anchor WMA Managers

Timeframe: Spring - Fall 2021 and annually

STRATEGY 4.2

Convert a minimum of 1,200 acres per TWRA Region annually of forested lands to early successional plant communities with combined timber harvest and prescribed burn projects.

Primary Responsibility: Forestry Managers, Forestry Coordinator, WMA Coordinators

Timeframe: Spring - Fall 2021 and annually

STRATEGY 4.3

In all forested portions of QFAs, aim reduce the basal area to 30 square feet or below.

Primary Responsibility: WMA Managers, Forestry Managers, WMA Coordinators, Habitat Biologists

Timeframe: Spring - Fall 2021 and annually

Stephen Thomas

Outreach Goal

Engage and educate stakeholders to help TWRA achieve the long-term vision of Northern Bobwhite conservation and management.

Objective 1

Improve and increase the frequency of interactions with internal and external stakeholders to encourage engagement in Northern Bobwhite conservation in Tennessee

STRATEGY 1.1

Coordinate and lead an annual meeting of stakeholders, managers, researchers, and students to guide and inform Northern Bobwhite conservation in Tennessee (TN Quail Summit). Working groups should include, but may not be limited to, research needs, current research, human dimensions, habitat manipulation, translocation, and monitoring. All Northern Bobwhite stakeholders in Tennessee should be invited to participate.

Primary Responsibility: Species Coordinator, Northern Bobwhite Management Team
Timeframe: Winter 2020 and annually

STRATEGY 1.2

Develop an effective outreach program to identify agricultural producers and other landowners in QFAs and directly contact to educate and engage in Northern Bobwhite management and conservation.

Primary Responsibility: Habitat Biologists, Outreach & Communication Division
Timeframe: Spring 2021 and ongoing

STRATEGY 1.3

Identify conservation organizations with interests near QFAs and directly contact to educate and engage in Northern Bobwhite management and conservation and emphasize the broad value of Northern Bobwhite habitat to other wildlife species.

Primary Responsibility: Habitat Biologists
Timeframe: Spring 2021 and ongoing

STRATEGY 1.4

Seek innovative ways to identify and effectively engage new Northern Bobwhite stakeholders.

Primary Responsibility: Species Coordinator, Northern Bobwhite Management Team, Habitat Biologists
Timeframe: Winter 2020 and ongoing

Objective 2

Seek opportunities to support and implement efforts of partners and conservation organizations to promote effective, science-based Northern Bobwhite conservation range-wide

STRATEGY 2.1

Leverage the annual TN Quail Summit outlined in Outreach Strategy 1.1 to identify new and innovative opportunities for cooperation and collaboration.

Primary Responsibility: Species Coordinator, Northern Bobwhite Management Team
Timeframe: Spring 2021 and ongoing

STRATEGY 2.2

Regularly and actively participate in partner organizations' meetings with a nexus for Northern Bobwhite conservation and management of early successional habitat, including NBCI, QF, NRCS, Audubon Society, Joint Ventures, etc.

Primary Responsibility: Species Coordinator, Northern Bobwhite Management Team
Timeframe: Fall 2020 and ongoing

STRATEGY 2.3

Encourage participation by stakeholders, volunteers and agency staff in non-TWRA Northern Bobwhite conservation activities , including the Breeding Bird Survey (BBS), Avian Knowledge Network (AKN), and eBird, etc.

Primary Responsibility: Species Coordinator, Northern Bobwhite Management Team, Avian Ecologist
Timeframe: Fall 2020 and ongoing

Objective 3

Educate hunters and other stakeholders about sustainable Northern Bobwhite hunting in Tennessee

STRATEGY 3.1

Develop mixed media educational materials about hunting and conservation focusing on Northern Bobwhite.

Primary Responsibility: Species Coordinator, Northern Bobwhite Management Team, Outreach & Communication Division

Timeframe: Spring 2021 - Fall 2021

STRATEGY 3.2

Distribute mixed media educational materials about hunting and conservation to hunting and non-hunting stakeholders identified in Outreach Strategy 1.2 and Outreach Strategy 1.3.

Primary Responsibility: Habitat Biologists, Regional Biologists, Outreach & Communication Division, Northern Bobwhite Management Team

Timeframe: Fall 2021 and ongoing

Objective 4

Outreach to stakeholders and volunteers for assistance with all Northern Bobwhite conservation work statewide

STRATEGY 4.1

Create a network of volunteers committed to Northern Bobwhite conservation in TN who are trained to assist with habitat work, outreach, and population and habitat monitoring.

Primary Responsibility: Species Coordinator, Anchor WMA Managers, Habitat Biologists

Timeframe: Winter 2020 and ongoing

STRATEGY 4.2

Engage trained volunteers and conservation partners to assist TWRA with public outreach, habitat work, annual population and habitat monitoring, reporting, and analysis as feasible.

Primary Responsibility: Species Coordinator, Anchor WMA Managers, Habitat Biologists

Timeframe: Spring 2021 and ongoing

Objective 5

Ensure that TWRA staff employ best management practices for Northern Bobwhite management

STRATEGY 5.1

Provide annual education to all TWRA staff involved in Northern Bobwhite management to ensure staff are knowledgeable and educated on current research and best management practices.

Primary Responsibility: Species Coordinator, Northern Bobwhite Management Team, Avian Ecologist

Timeframe: Winter 2020 and annually

STRATEGY 5.2

Create and maintain a manual of Best Management Practices to guide habitat and population monitoring and inventory efforts.

Primary Responsibility: Species Coordinator

Timeframe: Fall 2020 and ongoing

STRATEGY 5.3

Create and maintain a Northern Bobwhite Management Team that is led by the Species Coordinator and comprised of at least one representative from Forestry, Private Lands, WMAs and the Outreach & Communication Division. The team should meet at least 4 times a year to guide management of Northern Bobwhite and ensure the implementation of this Plan.

Primary Responsibility: Species Coordinator, Species Program Manager

Timeframe: Winter 2020 and four times annually

Population Goal

Through innovative management efforts, effective partnerships, and improved inventory and monitoring, increase the number of self-sustaining populations of Northern Bobwhite across Tennessee.

Objective 1

Monitor the status of Northern Bobwhite populations in QFAs and QDAs

STRATEGY 1.1

Annually assess Northern Bobwhite populations in QFAs and QDAs using methodologies based on current NBCI CIP Population Monitoring Protocols (Morgan et al. 2016) and update as necessary.

Primary Responsibility: Species Coordinator, QFA and QDA Managers, Habitat Biologists
Timeframe: Summer 2020 and ongoing

STRATEGY 1.2

Share monitoring data with appropriate partners to ensure effective range-wide management.

Primary Responsibility: Species Coordinator, Avian Ecologist
Timeframe: Winter 2020 and ongoing

STRATEGY 1.3

Use monitoring data to develop and adapt future management strategies including season dates, bag limits, and WMAs open to harvest.

Primary Responsibility: Species Coordinator, Regional Biologists
Timeframe: Spring 2022 and Spring 2024

STRATEGY 1.4

Expand inventory and monitoring activities to high priority habitats outside of QFAs and QDAs identified in Habitat Strategy 1.1 as funding allows.

Primary Responsibility: Habitat Biologists, Species Coordinator, landowners, volunteers
Timeframe: Spring 2023 and ongoing

Objective 2

Develop and implement feasible, standardized protocols to measure Northern Bobwhite harvest and hunter effort annually statewide

STRATEGY 2.1

Conduct annual Tennessee Small Game, Migratory Game Birds, and Furbearers Harvest Survey to measure Northern Bobwhite harvest and hunter effort annually.

Primary Responsibility: Species Coordinator
Timeframe: Spring 2021 and annually

STRATEGY 2.2

Assess the feasibility and utility of measuring harvest demographics such as sex & age classes and composition of domestic vs. wild birds in harvest using wing barrels and/or hunter diaries.

Primary Responsibility: Species Coordinator, Regional Biologists
Timeframe: Fall 2020 and ongoing

Research Goal

Working with partners, engage in priority research efforts to better understand the population and habitat needs of self-sustaining Northern Bobwhite populations in Tennessee.

Objective 1

Document and monitor fundamental population characteristics of Northern Bobwhite in QFAs and QDAs, including sex- and age-specific survival, habitat use, mortality, morbidity, and reproductive success to inform best management practices

STRATEGY 1.1

Develop and fund a research project to document the population demographics of Northern Bobwhite in QFA and QDAs.

Primary Responsibility: Species Coordinator
Timeframe: Winter 2020 - Fall 2024

STRATEGY 1.2

Customize CIP protocols for each QFA and QDA to specify particulars such as sample sizes, locations, dates, etc.

Primary Responsibility: Species Coordinator, Avian Ecologist, Support Biologist
Timeframe: Fall 2020 and annually

Objective 2

Collaboratively identify areas of critical information gaps and guide coordinated research efforts to benefit Northern Bobwhite management in Tennessee

STRATEGY 2.1

Leverage annual TN Quail Summit outlined in Outreach Strategy 1.1 to regularly share information, understand research needs and prioritize funding and personnel with university researchers and partner organizations.

Primary Responsibility: Species Coordinator
Timeframe: Spring 2021 and ongoing

STRATEGY 2.2

Encourage graduate and undergraduate student participation in TWRA's Northern Bobwhite management activities through formal agreements with universities and colleges.

Primary Responsibility: Species Coordinator
Timeframe: Fall 2020 and ongoing

Objective 3

Identify and rank areas for potential Northern Bobwhite translocations based on best translocation practices and guidelines as identified in (NBCI & NBTC 2019)

STRATEGY 3.1

Using maps generated from Habitat Strategy 1.1, identify TWRA-owned lands that meet or exceed translocation habitat requirements of a minimum of 1,500 acres of year-round, high-quality Northern Bobwhite habitat that makes up a minimum of 25 percent of the total acreage and ground truth potential parcels.

Primary Responsibility: Species Coordinator, Northern Bobwhite Management Team, WMA Coordinators, WMA Managers
Timeframe: Winter 2022

STRATEGY 3.2

Develop and maintain a thorough ranking system of all potential Northern Bobwhite translocation sites identified in Research Strategy 3.1, that includes habitat quality, connectivity to other high-quality habitats, security of the habitat, current density of Northern Bobwhite, and potential for future condition.

Primary Responsibility: Species Coordinator, Northern Bobwhite Management Team, WMA Coordinators, WMA Managers
Timeframe: Spring 2023 and annually

Objective 4

Explore the re-establishment and/or supplementation of Northern Bobwhite populations, using wild source populations only, in areas identified in Research Objective 3

STRATEGY 4.1

Identify source populations for wild birds in Tennessee and from partner states.

Primary Responsibility: Species Coordinator, Species Program Manager, Wildlife Division Chief
Timeframe: Summer 2023

STRATEGY 4.2

Develop specific, individualized post-release management plans for each release area identified in Research Objective 3. Plans will include long-term habitat and population monitoring protocols.

Primary Responsibility: Species Coordinator, WMA Managers, Regional Biologists
Timeframe: Summer 2023

STRATEGY 4.3

Propose translocation of Northern Bobwhites, as feasible, to release sites identified in Research Objective 3, using NBCI Northern Bobwhite Translocation Guidelines (NBCI and NBTC 2019).

Primary Responsibility: Species Coordinator, Species Program Manager
Timeframe: Fall 2023

Northern Bobwhite and pollinating insects need a diversity of plants to thrive. Pollinating insects also provide food for Bobwhite and Bobwhite chicks.

Stephen Thomas

Glossary

Adaptive management: The practice of conducting management as experiments so that data can be collected and used to evaluate success of the management action and used to further refine management programs.

Anchor Wildlife Management Area (Anchor WMA): TWRA-owned Wildlife Management Area situated within a Quail Focal Area that prioritizes Northern Bobwhite habitat management.

Avian Knowledge Network: The Avian Knowledge Network (AKN) is a collaborative effort between a multitude of stakeholders to facilitate and enhance bird conservation. The AKN consists of a variety of interactive tools, data products and information, including a database to store and analyze bird population data. http://avianknowledge.net/

Best management practices: Effective and practical management actions based on the best available science.

Breeding Bird Survey: The BBS is a cooperative effort between the U.S. Geological Survey's Patuxent Wildlife Research Center and Environment Canada's Canadian Wildlife Service to monitor the status and trends of North American bird populations. https://www.pwrc.usgs.gov/bbs/

Early successional habitat: Plant communities that develop immediately after a disturbance such as timber harvest, fire, or disking. The communities are critical for sustainable Bobwhite populations.

eBird: An online citizen-science database of global bird sightings managed by Cornell Lab of Ornithology. The data are uploaded by individuals, analyzed and made available to anyone. https://ebird.org/home

Geographical Information System (GIS): A computerized system of capturing, storing, manipulating, analyzing, managing, presenting and displaying spatial and geographic data.

Joint Venture: Partnerships of states, federal agencies, organizations, and others that have been formed to implement conservation programs for all species of birds across the geographic extent of species ranges. Examples include Gulf Coast Joint Venture, Oaks and Prairies Joint Venture, and Central Hardwoods Joint Venture.

Old field: Former agricultural lands that have been left fallow and early successional habitat has developed. In Tennessee, old fields provide substantial habitats to Northern Bobwhite.

Quail Focal Areas (QFAs): A contiguous, targeted area designed to increase the probability of achieving NBCI managed Northern Bobwhite densities (i.e., huntable populations) through strategic habitat management efforts in the near-term.

Stakeholder: Individuals or groups that impact Northern Bobwhite or are impacted by Northern Bobwhite. This includes, hunters, non-hunters, conservation organizations, state wildlife agencies, land management agencies and many others.

References

Allen, C. R., J. J. Fontaine, K. L. Pope, and A. S. Garmestani. 2011. Adaptive management for a turbulent future. Journal of Environmental Management 92:1339–1345.

Brennan, L. A. 1991. How Can We Reverse the Northern Bobwhite Population Decline? Wildlife Society Bulletin 19:544–555. [Wiley, Wildlife Society].

Burger, L. W. 1999. Economic Impact of Northern Bobwhite Hunting in the Southeastern United States. Wildlife Society Bulletin 27:1010–1018.

Burger, L. W. 2001. Northern Bobwhite. Pages 122–146 in J. G. Dickson, editor. Wildlife of Southern Forests, Habitat and Management. Hancock House Publishers, Surry, BC, Canada and Blaine, WA, USA.

Dimmick, R. W. 1971. The Influence of Controlled Burning on Nesting Patterns of Bobwhite in West Tennessee. Pages 149–155 in. Proceedings of the Annual Conference of the Southeastern Association of Game and Fish Commissioners. Volume 25.

eBird Basic Dataset. Version: EBD_relMay-2017. Cornell Lab of Ornithology, Ithaca, New York. May 2017

Estes, D. M. 2016. A Guide to Grasslands of the Mid-South. Austin Peay State University, Clarksville, TN, USA.

Eubanks, T. R., and R. W. Dimmick. 1974. Dietary patterns of bobwhite quail on Ames Plantation -- Implications for management. University of Tennessee Agricultural Experiment Station, Knoxville, TN, USA.

Evans, K. O., M. D. Smith, L. W. Burger Jr., R. J. Chambers, A. E. Houston, and R. Carlisle. 2009. Release of Pen-Reared Bobwhites: Potential Consequences to the Genetic Integrity of Resident Wild Populations. Pages 121–133 in. National Quail Symposium Proceedings.

Grizzle, J. M., D. B. Kersten, A. E. Houston, and A. M. Saxton. 2005. Effect of chronic vs. intermittent exposure to T-2 toxin on reproductive performance in bobwhite quail. International Journal of Poultry Science 4:71–75.

Grizzle, J. M., D. B. Kersten, M. D. McCracken, A. E. Houston, and A. M. Saxton. 2004. Determination of the acute 50% lethal dose T-2 toxin in adult bobwhite quail: additional studies on the effect of T-2 mycotoxin on the blood chemistry and morphology of internal organs. Avian Diseases 48:392–399.

Gudlin, M. J., A. S. Wilcox, K. E. Fagan, and R. D. Applegate. 2019. Survey of Tennessee landowners participating in Conservation Reserve Program practice focused on restoring native grasslands and northern bobwhite in Tennessee. Journal of the Southeastern Association of Fish and Wildlife Agencies 6:111–116.

Guthery, F. S., M. J. Peterson, and R. R. George. 2000. Viability of Northern Bobwhite Populations. The Journal of Wildlife Management 64:646–662. [Wiley, Wildlife Society].

Harper, C. A. 2017. Managing Early Successional Plant communities for Wildlife in the Eastern U.S. University of Tennessee Cooperative Extension, Knoxville, TN, USA.

Harper, C. A., G. E. Bates, M. J. Gudlin, and M. P. Hansbrough. 2004. A Landowners Guide to Native Warm-Season Grasses in the Mid-South. University of Tennessee Cooperative Extension, Knoxville, TN, USA.

Harper, C. A., G. E. Bates, M. P. Hansbrough, M. J. Gudlin, J. P. Gruchy, and P. D. Keyser. 2007. Native Warm-Season Grasses: Identification, Establishment and Management for Wildlife and Forage Production in the Mid-south. University of Tennessee Cooperative Extension, Knoxville, TN, USA.

Lake, L. A., D. A. Buehler, and A. E. Houston. 2002. Cooper's hawk non-breeding habitat use and home range in southwestern Tennessee. Pages 229–238 in. Proceedings of the Southeastern Association of Fish and Wildlife Agencies.

Marcum, L. D. 1975. Evaluation of the game farm program in Tennessee. Tennessee Wildlife Resources Agency, Nashville, TN, USA.

McRae, W. A., and R. W. Dimmick. 1982. Body fat and blood-serum values of breeding wild bobwhites. Journal of Wildlife Management 46:268–271.

Miller, K. S., L. A. Brennan, H. L. Perotto-Baldivieso, F. Hernandez, and E. D. Grahmann. 2019. Correlates of habitat fragmentation and northern bobwhite abundance in the Gulf Prairie Landscape Conservation Cooperative. Journal of Fish and Wildlife Management 10:3–18.

Minser, W. G., and R. W. Dimmick. 1988. Bobwhite quail use of no-till versus conventionally planted crops in western Tennessee. Journal of Soil and Water Conservation 43:270–272.

Morgan, J. J., K. K. Duren, and T. V. Dailey. 2016. NBCI Coordinated Implementation Program v1.1. Addendum, The National Bobwhite Conservation Initiative: A range-wide plan for recovering bobwhites. National Bobwhite Technical Committee Technical Publication, ver. 2.0. National Bobwhite Conservation Initiative, Knoxville, TN, USA.

Organ, J., V. Geist, S. Mahoney, S. Williams, P. Krausman, G. Batcheller, T. Decker, R. Carmichael, P. Nanjappa, R. Regan, R. Medellín, R. Cantu, R. McCabe, S. Craven, and G. Vecellio. 2012. The North American Model of Wildlife Conservation.

Pardieck, K. L., D. J. Ziolkowski Jr., M. Lutmerding, V. Aponte, and M.-A. R. Hudson. 2019. North American Breeding Bird Survey Dataset 1966 - 2018, version 2018.0. U.S. Geological Survey, Patuxent Wildlife Research Center. <https://doi.org/10.5066/P9HE8XYJ>. Accessed 31 Mar 2020.

Rolland, V., J. Hostetler, T. Hines, H. Percival, and M. Oli. 2010. Impact of harvest on survival of a heavily hunted game bird population. Wildlife Research 37:392–400.

Rosenberg, K. V., J. A. Kennedy, R. Dettmers, R. P. Ford, D. Reynolds, J. D. Alexander, C. J. Beardmore, P. J. Blancher, R. E. Bogart, G. S. Butcher, A. F. Camfield, A. Couturier, D. W. Demarest, W. E. Easton, J. J. Giocomo, R. H. Keller, A. E. Mini, A. O. Panjabi, D. N. Pashley, T. D. Rich, J. M. Ruth, H. Stabins, J. Stanton, and T. Will. 2016. Partners in Flight Landbird Conservation Plan: 2016 Revision for Canada and Continental United States. Partners in Flight Science Committee.

Sands, J. 2010. Testing sustained-yield harvest theory to regulate northern bobwhite hunting. ProQuest Dissertations Publishing.<http://search.proquest.com/docview/900303303/?pq-origsite=primo>. Accessed 28 Apr 2020.

Stoddard, H. L. 1931. Bobwhite Quail: Its Habits, Preservation, and Increase. Charles Scribner's Sons, New York, NY, USA.

Tennessee State Wildlife Action Plan Team. 2015. Tennessee State Wildlife Action Plan 2015. Tennessee Wildlife Resources Agency, Nashville, TN, USA.

Tennessee Wildlife Resources Agency. 2008. Results from Online Game Harvest Survey 2007-2008. Unpublished. Nashville, TN, USA.

Tennessee Wildlife Resources Agency. 2009. Results from Online Game Harvest Survey 2008-2009. Unpublished. Nashville, TN, USA.

Tennessee Wildlife Resources Agency. 2013. Tennessee Northern Bobwhite Quail Restoration Plan, TWRA Wildlife Technical Report 13-9. Nashville, TN, USA.

Tennessee Wildlife Resources Agency. 2018. Evaluation of Tennessee Bobwhite Focus Areas. TWRA Wildlife Technical Report 18-2. Nashville, TN, USA.

Terhune, T. M., D. C. Sisson, W. E. Palmer, B. C. Faircloth, H. L. Stribling, and J. P. Carroll. 2010. Translocation to a fragmented landscape: survival, movement, and site fidelity of Northern Bobwhites. Ecological Applications 20:1040–1052.

The National Bobwhite Conservation Initiative and The National Bobwhite Technical Committee. 2019. Position Statement and Guidelines for Interstate Translocation of Wild Northern Bobwhites.

The National Bobwhite Technical Committee. 2011. The National Bobwhite Conservation Initiative: A range-wide plan for recovering bobwhites. Version 2.0. W. E. Palmer, T. M. Terhune, and D. F. McKenzie, editors. National Bobwhite Conservation Institute, Knoxville, TN, USA.

The National Bobwhite Technical Committee. 2020. The Comprehensive Guide to Creating, Improving & Maintaining Bobwhite Habitat. The National Bobwhite Conservation Initiative.

<https://bringbackbobwhites.org/download/nbci-the-comprehensive-guide-to-creating-improving-managing-bobwhite-habitat/>. Accessed 1 Apr 2020.

US Department of the Interior, US Fish and Wildlife Service, and US Department of Commerce, US Census Bureau. 2012. 2011 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation. Washington DC, USA.

Warwick, J. A., and C. A. Harper. 2018. Considerations for wildlife and fire in the southern Blue Ridge. University of Tennessee Cooperative Extension, Knoxville, TN, USA.

Williams, C. K., R. S. Lutz, and R. D. Applegate. 2004. Winter Survival and Additive Harvest in Northern Bobwhite Coveys in Kansas. Journal of Wildlife Management 68:94–100. Blackwell Publishing Ltd, Oxford, UK.